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For : **NEIGHBORING BASE STATION INFORMATION UPDATING METHOD, INFORMATION MANAGEMENT METHOD FOR CELL SEARCH IN MOBILE COMMUNICATION SYSTEM, CELL SEARCH METHOD OF MOBILE STATION, MOBILE COMMUNICATIONS SYSTEM, BASE STATION AND CONTROL STATION**

TRANSLATION OF PRIORITY DOCUMENTS AND DECLARATION IN SUPPORT THEREOF

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

I, Kiyoe Kabashima, of Tani & Abe Patent Office, No. 6-20, Akasaka 2-chome, Minato-ku, Tokyo 107-0052, Japan, declare that:

1. I am proficient in both Japanese and English languages.
2. I have reviewed the English translation of Japanese Patent Application No.11-168899, a copy of which is attached hereto.
3. The attached English translation of the Japanese application identified in paragraph 2 above is a true and correct translation to the best of my knowledge and belief.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed this 5th day of June, 2007

Kiyoe KABASHIMA

[DOCUMENT NAME] SPECIFICATION

[TITLE OF THE INVENTION] INFORMATION MANAGEMENT METHOD FOR CELL SEARCH IN MOBILE COMMUNICATIONS SYSTEM, CELL SEARCH METHOD OF MOBILE STATION, BASE STATION, HOST STATION AND MOBILE STATION, AND MOBILE COMMUNICATIONS SYSTEM

[SCOPE OF CLAIM FOR A PATENT]

[Claim 1] An information management method for cell search in a mobile communications system to which direct sequence CDMA communications approach is applied, said method characterized by comprising:

a capturing step of capturing, in a handover-source base station, phase difference information between a long period spreading code of a common control channel from said handover-source base station and a long period spreading code of a common control channel from a handover-destination base station, the phase difference information being calculated by at least one mobile station that is communicating with said handover-source base station; and

a storing step of storing the captured phase difference information in at least one of said handover-source base station and/or its host station.

[Claim 2] The information management method for cell search in a mobile communications system as claimed in claim 1, characterized in that said handover-source base station and/or its host station stores an average of a plurality of pieces of the phase difference information between the long period spreading code of the common control channel from said handover-source base station and the long period spreading code of the common control channel from said handover-destination base station, the plurality of pieces of the phase difference information being captured from a plurality of mobile stations that are communicating with said handover-source base station.

[Claim 3] The information management method for cell search in a mobile communications system as claimed in claim 1 or 2, characterized in that said host station storing said phase difference information supplies to said base station said phase difference information between said base station and its neighboring base stations from among said stored phase difference information.

[Claim 4] A cell search method of a mobile station in a mobile communications system to which direct sequence CDMA communications approach is applied, characterized in that, during a standby mode or when a soft handover mode is entered, said phase difference information is captured from a handover-source base station as set forth in any of claims 1 to 3, and a cell search is executed within a predetermined time range based upon said captured phase difference information.

[Claim 5] A base station to which the information management method as claimed in any of claims 1 to 3 is applied, characterized by comprising:

storing means for storing phase difference information between said base station and a neighboring base station of said base station, the phase difference information being captured from a mobile station; and

management means for managing the phase difference information stored in said storing means.

[Claim 6] A base station to which the information management method as claimed in any of claims 1 to 3 is applied, characterized by comprising:

storing means for storing phase difference information between said base station and a neighboring base station of said base station, the phase difference information being supplied from a host station storing phase difference information of any of claims 1 to 3; and

management means for managing the phase difference information stored in said storing means.

[Claim 7] A host station to which the information management method as claimed in any of claims 1 to 3 is applied, said host station comprising:

capturing means for capturing said phase difference information stored in storage means of the base station from the base station of claim 5;

storing means for storing said phase difference information acquired by said capturing means;

management means for managing the phase difference information stored in said storing means.

[Claim 8] A mobile station in the mobile communications system to which direct sequence CDMA communications approach is applied, said mobile station characterized by comprising:

first storing means for storing types of long period spreading codes of a predetermined number of base stations to be subjected to the cell search, the types being notified from said base station of claim 5 or 6;

second storing means for storing types of long period spreading codes of the base stations to be subjected to the cell search, the types corresponding to the phase difference information being notified from said base station of claim 5 or 6;

comparing means for comparing information stored in said first storing means with information stored in said second storing means; and

a cell search means for executing the cell search of claim 4 in response to a comparison result obtained by said comparing means.

[Claim 9] A mobile communications system characterized by comprising:

a base station of claim 5 or claim 6;

a host station of claim 7; and

a mobile station of claim 8.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field to Which the Invention Pertains]

The present invention relates to an information management method for a cell search in a mobile communications system to which a direct sequence CDMA (DC-CDMA) communications approach for providing multiple access by using spread spectra is applied, a cell search method of a mobile station, a base station, a host station and a mobile station, and a mobile communications system.

[0002]

[Prior Art]

Direct Sequence CDMA (DS-CDMA) is a scheme for a plurality of users to execute communications using the same radio frequency band by transmitting information through secondary modulation that spreads a conventional information data modulation signal with a high rate spreading code. Each user is identified by a spreading code assigned to the user. Therefore, a receiver must convert its wideband received input signal to the original narrow-band signal by a process called despreading before it carries out ordinary demodulation. In the course of the despreading, the receiver carries out correlation detection between the received signal and a spreading code replica synchronized to the spreading code phase of the received signal. In particular, synchronization between the spreading code replica of the receiver and the spreading code phase of the received signal at the start of communication is called “initial acquisition”.

[0003]

A normal initial acquisition scheme of a spreading code is performed by multiplying the received signal by the spreading code replica on the receiving side, by calculating correlation between the two signals by integrating the product over a particular interval, and by carrying out square-law detection, followed by making a decision as to whether the synchronization is established depending on whether the output exceeds a threshold value. To detect the correlation, there are two methods: one uses a sliding correlator that carries out a time integral; and the other uses a matched filter that carries out a spatial integral. The matched filter is configured by placing a plurality of sliding correlators in parallel, and hence it can calculate correlation values over multiple tips instantaneously by varying the spreading code replicas of respective taps in accordance with the spreading code. Accordingly, it is much faster than the sliding correlator, although its circuit scale and current consumption are greater than those of the sliding correlator.

[0004]

The research-and-development and standardization have been underway of a wideband DS-CDMA system (abbreviated to W-CDMA system from now on) with a spread bandwidth of more than 5 MHz as a candidate of a next generation mobile communications system called IMT-2000. The W-CDMA system is an asynchronous system in which base stations each operate on independent time bases.

[0005]

Fig. 1 illustrates spreading code assignment schemes in a down-link in an inter-base station asynchronous system and a synchronous system. The cdma 2000 system or IS-95 proposed in the United States as a candidate of the IMT-2000 just as the W-CDMA, implements the inter-base station synchronization using the GPS.

[0006]

Thus, the inter-base station synchronous system has a common time base for all the base stations, and hence the base stations can use the same spreading code with providing different delays for individual base stations. Accordingly, it is enough for the initial acquisition of the inter-base station synchronous system to only establish timing synchronization of the spreading code. On the other hand, since the inter-base station asynchronous system has no common time base for the base stations, the base stations employ different long codes (called scrambling codes because they convert signals from other cells into noise) to identify themselves. When power is turned on, a mobile station must establish the long code synchronization of a downlink common control channel from a cell site to connect itself to a base station (cell site) that provides the greatest power of the received signal. This operation is referred to as "cell search" in the sense that a cell site to which a radio channel is to be connected is searched for. In the inter-base station asynchronous system, the mobile station must execute the cell search of all the long codes assigned to the system. In contrast, as for the inter-base station synchronous system, since the long code is limited to one type, it will be obvious that it can perform cell search, that is, establish long code synchronization of the downlink common control channel in a much shorter period than the asynchronous system.

[0007]

The spreading code synchronization scheme disclosed in Japanese Patent Application Nos. 9-531660 and 9-355906 assigned to the assignee of the present application can speed up the cell search (long code synchronization of the downlink common control channel) of the inter-base station asynchronous system comparable to that of the inter-base station synchronous system. Specifically, the spreading code synchronization scheme takes the following steps as illustrated in Fig. 2. A perch channel (a channel to which the mobile station connects a radio link at the beginning of communication) is doubly spread by a short code that has the same cycle period as the symbol period and is used in common by all the base stations, and by a long code different from base station to base station; the long code spreading is masked at fixed intervals (in other words, the masked portions do not undergo the long code spreading) so that portions spread by only the short code are generated (a symbol spread by only the common short code is called a masking symbol from now on). Since the short code is common to all the base stations, the mobile station calculates the correlation with the common short code that is used as the spreading code replica with the matched filter so that a peak is detected at the received timing of the short code spreading portions of the received signal independently of the type of the long codes. Storing the time of the correlation peaks in accordance with the timing of the masking symbols make it possible to establish the timing synchronization of the long code. After that, it is enough for the mobile station to identify the type of the long code that spreads the received signal, which is executed by detecting the correlation at the timing that has already been obtained by using 0the spreading code generated by multiplying the short code by the long code, and by making a threshold value decision.. This fast 3-step cell search method using the long code mask can implement a fast cell search even in the inter-base station asynchronous system.

[0008]

The above is the description of the cell search of the mobile station in the initial acquisition. In a cellular system, however, the cell site providing the mobile station with the greatest received power, that is, the cell site to which the radio link is to be connected, changes as the mobile station moves during the communication. To execute switching between the cell sites (soft handover), the receiver must regularly measure the received levels of the neighboring cell sites of the current cell site by establishing spreading code synchronization of the downlink perch channels. In the cell search at the soft handover, since the mobile station is notified of the types of the long codes of the neighboring cell sites from the current cell site, the cell search time becomes shorter than that in the initial acquisition.

[0009]

Furthermore, the mobile station regularly carries out the cell search in the standby mode to search for a cell site to be connected when starting a traffic channel. In this case, since the mobile station is also notified of the types of the long codes of the neighboring cell sites from the final cell site before entering the standby mode via the control channel, the cell search time also becomes shorter than that in the initial acquisition.

[0010]

[Problems to Be Solved by the Invention]

Since the inter-base station synchronous system utilizes only a single type long code, the individual cell sites use the long code by shifting it by a fixed time (by a fixed number of chips of the long code). Therefore, in the inter-base station synchronous system, it is enough to execute the search in only a search window around the long code phase that is shifted by the fixed time (fixed number of chips) from the long code phase of the perch channel of the final cell site before entering the standby mode in the case of the cell search in the standby mode, or of the current cell site during the handover in the case of the cell search in the handover mode. Thus, it is possible to conduct a quick cell search. Here, the search window refers to a search range obtained when considering the propagation delay from each cell site.

[0011]

In the foregoing inter-base station asynchronous system, however, since the long code phase of the perch channel of the final cell site before entering the standby mode, or the long code phase of the perch channel of the current cell site in the soft handover mode has nothing to do with the long code phases of the neighboring cell sites, basically, the 3-step cell search in the foregoing initial acquisition using the long code mask must be executed. Thus, it takes rather longer cell search time than the synchronous system. Therefore, the inter-base station asynchronous system has a problem of increasing the consumption power of the mobile station than the synchronous system especially in the standby mode, because the mobile station must operate its demodulating circuit longer.

[0012]

Therefore, an object of the present invention is to implement fast cell search when the mobile station enters a standby mode or soft handover mode in an inter-base station asynchronous system.

[0013]

[Means for Solving the Problems]

In order to the foregoing object, the invention of claim 1 is directed to an information management method for cell search in a mobile communications system characterized by comprising:

capturing, in a handover-source base station, phase difference information between a long period spreading code of a common control channel from the handover-source base station and a long period spreading code of a common control channel from a handover-destination base station, the phase difference information being calculated by at least one mobile station that is communicating with the handover-source base station; and storing the captured phase difference information in at least one of the handover-source base station and its host station.

[0014]

The invention of claim 2 is directed to an information management method for cell search in a mobile communications system as claimed in claim 1, characterized in that the handover-source base station and/or its host station stores an average of a plurality of pieces of the phase difference information between the long period spreading code of the common control channel from said handover-source base station and the long period spreading code of the common control channel from said handover-destination base station, the plurality of pieces of the phase difference information being captured from a plurality of mobile stations that are communicating with said handover-source base station.

[0015]

The invention of claim 3 is directed to an information management method for cell search in a mobile communications system as claimed in claim 1 or claim 2, characterized in that said host station storing said phase difference information supplies to said base station said phase difference information between said base station and its neighboring base stations from among said stored phase difference information.

[0016]

The invention of claim 4 is directed to a cell search method of a mobile station in a mobile communications system to which direct sequence CDMA communications approach is applied, characterized in that, during a standby mode or when a soft handover mode is entered, said phase difference information is captured from a handover-source base station of any of claims 1 to 3, and a cell search is executed within a predetermined time range based upon said captured phase difference information.

[0017]

The invention of claim 5 is directed to a base station to which the information management method as claimed in any of claims 1 to 3 is applied, characterized by comprising:

storing means for storing phase difference information between said base station and a neighboring base station of said base station, the phase difference information being captured from a mobile station; and

management means for managing the phase difference information stored in said storing means.

[0018]

The invention of claim 6 is directed to a base station to which the information management method as claimed in any of claims 1 to 3 is applied, characterized by comprising:

storing means for storing phase difference information between said base station and a neighboring base station of said base station, the phase difference information being supplied from a host station storing phase difference information of any of claims 1 to 3; and

management means for managing the phase difference information stored in said storing means.

[0019]

The invention of claim 7 is directed to a host station to which the information management method as claimed in any of claims 1 to 3 is applied, said host station comprising:

capturing means for capturing said phase difference information stored in storage means of the base station from the base station of claim 5;

storing means for storing said phase difference information acquired by said capturing means;

management means for managing the phase difference information stored in said storing means.

[0020]

The invention of claim 8 is directed to a mobile station in the mobile communications system to which direct sequence CDMA communications approach is applied, said mobile station characterized by comprising:

first storing means for storing types of long period spreading codes of a predetermined number of base stations to be subjected to the cell search, the types being notified from said base station of claim 5 or 6;

second storing means for storing types of long period spreading codes of the base stations to be subjected to the cell search, the types corresponding to the phase difference information being notified from said base station of claim 5 or 6;

comparing means for comparing information stored in said first storing means with information stored in said second storing means; and a cell search means for executing the cell search of claim 4 in response to a comparison result obtained by said comparing means.

[0021]

The invention of claim 9 is directed to a mobile communications system characterized by comprising:

a base station of claim 5 or claim 6;

a host station of claim 7; and

a mobile station of claim 8.

[0022]

[Preferred Embodiments of the Invention]

Although it will be described later in detail, the base station in accordance with the present invention comprises a storing means for storing long code phase difference information reported via an uplink control channel from the mobile station; and a management means for managing the long code phase difference information stored in the storing means. The management means has two functions: sending the long code phase difference information stored in the storing means to a radio network controller (RNC), a host station (higher level station); and sending necessary information in the long code phase difference information stored in the storing means to the mobile station. The storing means can be executed by a control means such as a computer usually installed in the base station, and the two functions can be executed by the control means.

[0023]

The base station according to another embodiment of the present invention can comprise a storing means for storing long code phase difference information delivered from the host station, and a management means for managing the long code phase difference information stored in the storing means. The management means has a function to notify the mobile station of necessary information of the long code phase difference information stored in the storing means. The storing means can be executed by a control means such as a computer usually installed in the base station, and the function is executed by the control means.

[0024]

The host station according to the present invention comprises a storing means for storing long code phase difference information sent from the base stations, and a management means for managing the long code phase difference information stored in the storing means. The management means has a function to notify the base stations of necessary information of the long code phase difference information stored in the storing means. The storing means can be executed by a control means such as a computer usually installed in the host station, and the function is executed by the control means.

[0025]

The mobile station as an embodiment of the present invention has a function to calculate the long code phase difference information, and a cell search function as will be described later. The long code phase difference information calculating function is described in Volume 3, "Specification of Air-Interface for 3G Mobile System Ver. 1.0", Association of Radio Industries and Businesses (ARIB), Jan. 14, 1999.

[0026]

Fig. 3 is a diagram illustrating a procedure for storing long code phase difference information in the present embodiment.

[0027]

The mobile station 1 makes soft handover (SHO) from a base station A to a base station B. The mobile station 1 measures the difference between the long code phase of the perch channel of the handover-source base station A and the long code phase of the perch channel of the handover-destination base station B at the soft handover (shown as step 1 in Fig. 3), and notifies the handover-source base station A of the measured long code phase difference information via the control channel (shown as step 2 in Fig. 3). The base station A captures the long code phase difference information via the control channel and stores it in the storing means, where the long code phase difference information is the difference between the long code phase of the perch channel of the handover-source base station A and the long code phase of the perch channel of the handover-destination base station (any one of the base stations B, C and D in Fig. 3), which each mobile station communicating with the base station A measures during the soft handover. Each of the remaining base stations (B, C and D in Fig. 3) also captures the long code phase difference information via the control channel and stores it in the storing means, where the long code phase difference information is the difference between the long code phase of the perch channel of the handover-source base station and the long code phase of the perch channel of the handover-destination base station, which each mobile station communicating with the base station measures during the soft handover.

[0028]

Accordingly, all the base stations store in their storing means the long code phase difference information, that is, the difference between the long code phase of the perch channel of the handover-source base station and the long code phase of the perch channel of the handover-destination base station, which arises when a mobile station communicating with the base station performs the soft handover. Here, when a plurality of mobile stations, which communicate with the base station A via radio links interconnecting them, make soft handover to the base station B, the phase differences between the long code phases of the perch channels of the two base stations, which are measured by the respective mobile stations, can differ because of the difference in propagation delay at the measuring positions.

Thus, the base station A can average the phase differences between the long code phases of the perch channels of the base station A and base station B sent from the plurality of mobile stations, and obtain the average long code phase difference information, that is, the average phase difference information between the long code phases of the perch channels between the base station A and base station B. The average long code phase difference information can be updated every time each mobile station reports the phase difference information between the long code phases of the perch channels of the base station A and base station B. The base station A updates the long code phase difference information between it and the neighboring base stations. Furthermore, each base station notifies the host station of the stored long code phase difference information between it and the neighboring base stations via a wired network or the like. Each base station can obtain the long code phase difference information between it and the neighboring base stations from the host station via the wired network or the like. In addition, according to the information stored in the storing means, the base station or the host station can establish ranking of the neighboring base stations as needed in accordance with the number of times of the handover mobile stations communicating with the base station carry out to each of the neighboring base stations of the base station, during a predetermined interval from the present to the past.

[0029]

Fig. 4 illustrates an example of the management table in the storing means of the base station or host station. In this table, (1101001100...) in the column of the long code of the neighboring base stations represents a long code of a neighboring base station (base station B, for example); and Δ1 in the column of the long code phase difference information represents a measured value (measured by a mobile station) of the long code phase difference between the current station (base station A, for example) and a particular base station (base station B, for example).

[0030]

Fig. 5 is a diagram illustrating an example of a manner in which the base station sends the long code phase difference information to the mobile station.

[0031]

When the mobile station 2 communicating with the base station A via a radio link interconnecting them enters a standby mode thereafter, or makes soft handover to another base station, the base station A reports the long code phase difference information the base station A possesses (stored in the storing means as discussed above), that is, the relative phases (delay times) of the long codes of the perch channels of all the neighboring base stations with respect to that of the base station A.

[0032]

Thus, in the standby mode, the mobile station 2 can obtain the long code phase information of the perch channels of the final base station A and of the N neighboring base stations to which the base station A sends the relative phases of the downlink long codes. As a result, the mobile station in the standby mode can execute, for the reported long code phases of the perch channels of the N base stations, the long code synchronization and received level detection of the perch channels within a range of search windows, making it possible to execute the cell search in a very short time.

[0033]

Likewise, in the cell search for the neighboring base stations involved in entering the soft handover mode, the mobile station can execute the long code synchronization and received level detection of the neighboring base stations in a very short time by conducting a search on the relative downlink long code phases of the neighboring base stations sent from the handover-source base station, within the range of the search windows.

[0034]

Providing the long code phase information about the finally communicating base station and N neighboring base stations in the standby mode, or about the neighboring base stations in the soft handover is equivalent to the fact that the long code is shifted at fixed intervals along the time axis in the inter-base station synchronous system, and that the mobile station knows the long code phase timings shifted at every fixed intervals. Therefore, the fast cell search that is nearly equal to that of the inter-base station synchronous system can be executed in the standby mode and soft handover mode.

[0035]

[Embodiments]

An actual cell search method in the standby mode and soft handover mode will now be described in more detail. In the standby mode, a different cell search process is taken according to the relationship between numbers Ns and Nc. Ns is the number of the base station candidates that undergo the cell search in the standby mode, and is notified via a control channel from the base station which was connected to (connected via the radio link) immediately before the mobile station enters the standby mode (the base station having its traffic channel connected has the long code information about these base stations). Nc is the number of neighboring base stations whose relative phase information about the downlink long codes are possessed by the notifying base stations. Since the cell search when entering the soft handover mode is similar, only the cell search in the standby mode will be described below.

[0036]

Fig. 6 shows a configuration of the section for carrying out the cell search function in the mobile station. The reference numeral 3 designates a first cell search circuit for carrying out a first cell search function described later; 4 designates a second cell search circuit for carrying out a second cell search function described later; 5 designates a first memory circuit for storing the types of predetermined Ns scrambling codes for which the cell search is to be performed, that is, the long codes (base stations (BS) utilizing the long codes); 6 designates a second memory circuit for storing the types of scrambling codes for which the cell search is to be performed, that is, the long codes of the base stations (or the base stations using the long codes) that correspond to the relative phase differences of the Nc scrambling codes (long codes) notified from the base station establishing the radio link connection; and 7 designates a comparing circuit. The comparing circuit 7 compares information in the two memory circuits 5 and 6 to make a decision as to the relationship between the Nc and Ns provided from the base station communicating before entering the standby mode, whether Nc equals Ns (first case), Nc is greater than a few but less than Ns (second case), or Nc is less than a few (third case). In response to the decision result, it selects one of the first cell search circuit 3 and second cell search circuit 4 to have it execute the cell search.

[0037]

In the first case, the comparing circuit 7 selects the first cell search circuit 3. When Nc equals Ns, the mobile station has information about the types of the long codes and their relative phase information of all the base stations to be searched. Thus, the first cell search circuit 3 can execute the synchronization detection of the spreading codes of the downlink perch channels and the received level detection for respective phase timings within the range of the search windows.

[0038]

In the second case, the first cell search circuit 3 is selected so that, for the Nc base stations having the information about the types of their long codes and the relative phase information about the respective long codes, the circuit 3 carries out the synchronization detection of the spreading codes of the downlink perch channels and the received level detection for respective phase timings within the range of the search windows. Subsequently, the second cell search circuit 4 is selected so that for the neighboring base stations whose relative phase information about the long codes is not held by the base station connected to the traffic channel, the circuit 4 carries out the 3-step downlink spreading code synchronization detection and received level detection which will be described later (the 3-step downlink spreading code synchronization detection and received level detection is described in Japanese Patent Application Nos. 9-531660 and 9-355906.

[0039]

In the third case, the second cell search circuit 4 is selected so that for the neighboring base stations whose relative phase information about the long codes is not held by the base station connected to the traffic channel, the circuit 4 carries out the 3-step downlink spreading code synchronization detection and received level detection which will be described later.

[0040]

The first cell search circuit 3 executes the following processing for each base station whose relative phase information about the long code is reported. It generates a spreading code replica within a fixed time interval (within the search window) of the received timing of the long code; carries out a one-symbol integral with the sliding correlator using the spreading code replica; and detects the received power of the perch channel of the base station from the correlation power obtained by averaging the integrated correlation peaks over several symbols.

[0041]

In the 3-step cell search disclosed in Japanese Patent Application Nos. 9-

531660 and 9-355906, the perch channel is doubly spread using the short code common to all the base stations and the long code proper to the base station, in which the long code is removed (masked) by one symbol per slot at the fixed intervals. In the "Specification of Air-Interface for 3G Mobile System, Version 1.0" published by ARIB on January 14, 1999, the common short code at which the long code is masked is called a First Search Code (FSC). In addition, all the long codes to be searched, which are specific to the system, are grouped in advance, and a short code representing the group (which is called a Second Search Code (SSC)) is code multiplexed into the FSC. In the "Specification of Air-Interface for 3G Mobile System, Version 1.0", 16 SSCs in one frame are assigned 32 code patterns generated by Reed-Solomon coding so that the group detection and frame timing detection can be achieved at the same time.

[0042]

The second cell search circuit 4 carries out the cell search using the 3-step cell search described in Japanese Patent Application Nos. 9-531660 and 9-355906, for the base stations whose relative phase information about the long codes are not delivered (the base stations whose long code phase information is not held by the base station connected to the traffic channel). In the first step, a maximum peak is detected by averaging the power of the correlation peaks over an integer multiple of the slots by the matched filter using the FSC as the spreading code replica, and the timing of the peak is adopted as the received timing of the FSC of the base station to be searched. In the second step, the correlation detection is executed at the timing for each SSC of the 32 groups so that the long code group and frame timing are detected from the group whose correlation peak obtained by averaging over several frames is maximum. Finally, in the third step, the correlation detection is executed sequentially by the sliding correlator for the long codes belonging to the group detected in the second step so that the long code is identified by making the threshold value decision for the obtained correlation peak.

[0043]

[Advantageous Result of the Invention]

As described above, according to the present invention, a fast cell search comparable to that of the inter-base station synchronous system can be implemented during the standby and soft handover even in the inter-base station asynchronous system.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a diagram illustrating spreading code assignment schemes in a downlink of an inter-base station asynchronous system and that of an inter-base station synchronous system.

[Fig. 2]

Fig. 2 is a diagram illustrating an example of a transmitted signal when using a long code mask.

[Fig. 3]

Fig. 3 is a diagram illustrating an example of procedures for storing long code phase difference information in accordance with the present invention.

[Fig. 4]

Fig. 4 is a diagram showing an example of a management table stored in a storing means in a base station or a host station.

[Fig. 5]

Fig. 5 is a diagram illustrating a manner in which a base station sends the long code phase difference information to a mobile station.

[Fig. 6]

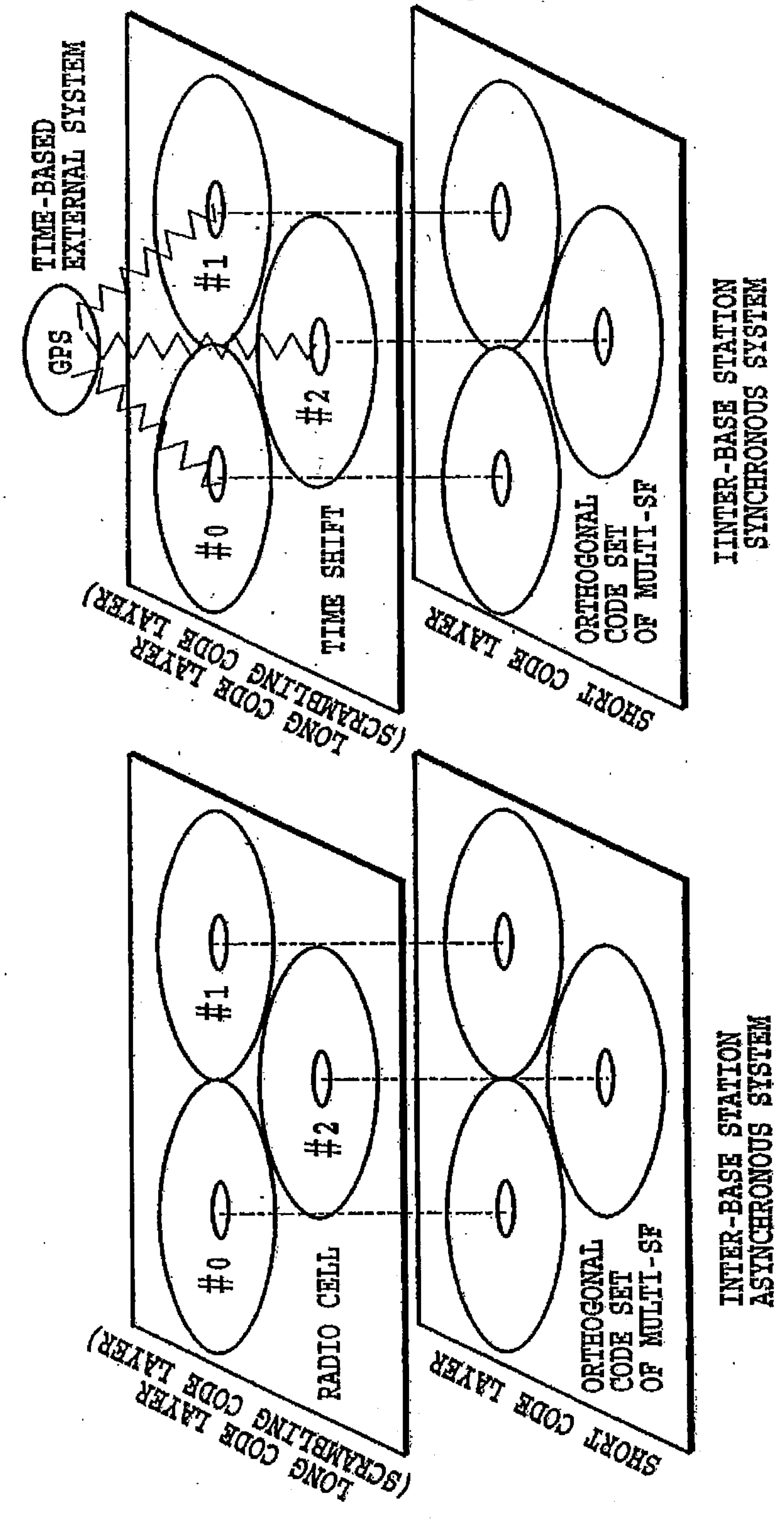
Fig. 6 is a block diagram showing a configuration of a portion implementing a cell search function in the mobile station.

[Reference Numerals]

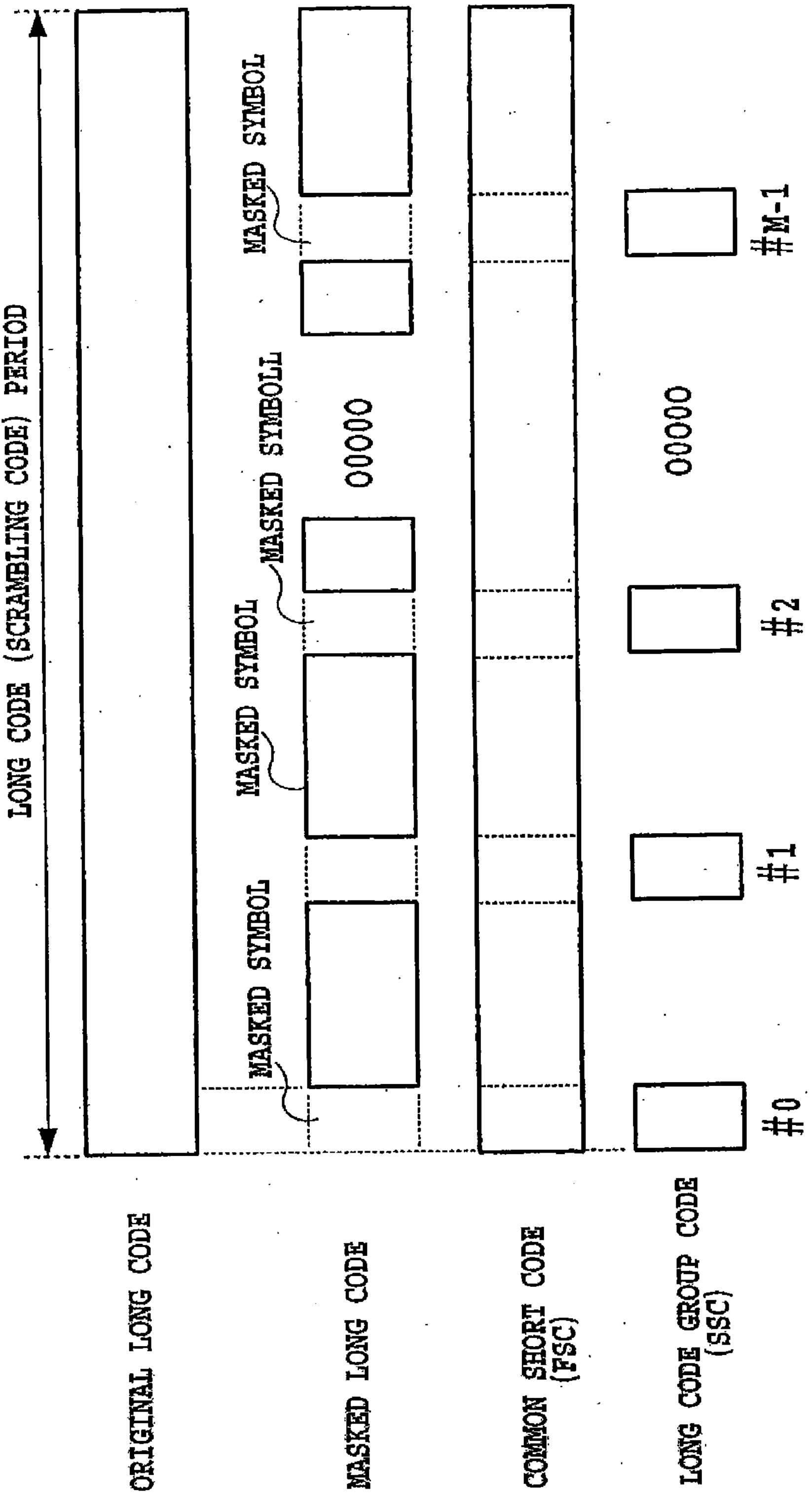
1... Mobile station
A, B, C, D... Base station
RNC... Host station

(DOCUMENT NAME) DRAWINGS

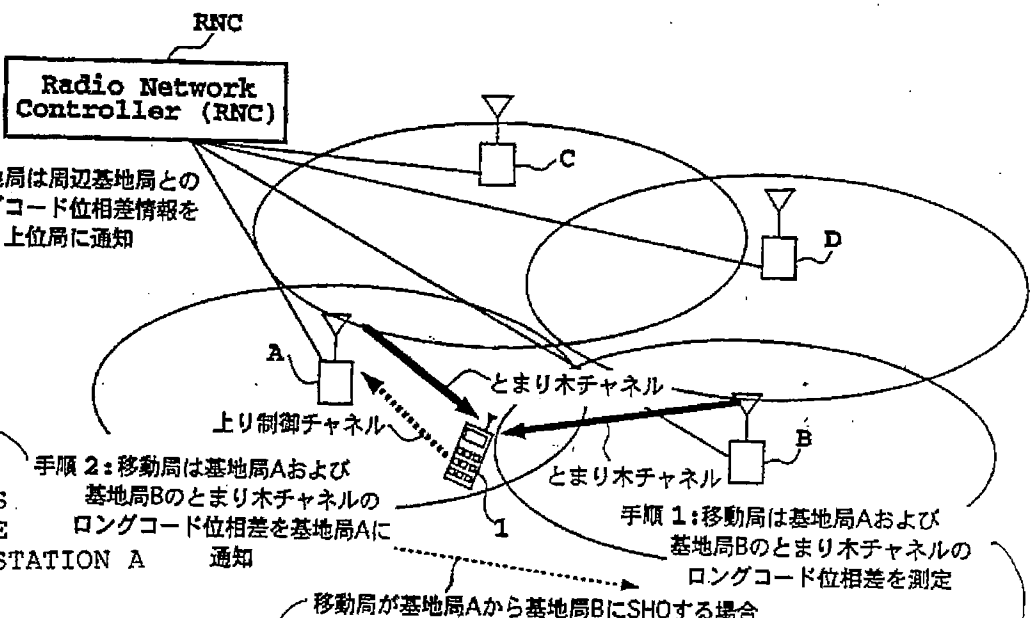
(Fig. 1)


TIME-BASED EXTERNAL SYSTEM
GPS
#0
#1
#2
TIME SHIFT
LONG CODE LAYER (SCRAMBLING CODE LAYER)
SHORT CODE LAYER
ORTHOGONAL CODE SET OF MULTI-SF
IINTER-BASE STATION SYNCHRONOUS SYSTEM
#0
#1
#2
RADIO CELL
LONG CODE LAYER (SCRAMBLING CODE LAYER)
SHORT CODE LAYER
ORTHOGONAL CODE SET OF MULTI-SF
INTER-BASE STATION ASYNCHRONOUS SYSTEM

(Fig. 2)


LONG CODE (SCRAMBLING CODE) PERIOD
MASKED SYMBOL
MASKED SYMBOLL
MASKED SYMBOL
MASKED SYMBOL
MASKED SYMBOL
00000
00000
#0
#1
#2
#M-1
ORIGINAL LONG CODE
MASKED LONG CODE
COMMON SHORT CODE
(FSC)
LONG CODE GROUP CODE
(SSC)

(Fig. 3)



EACH BASE STATION NOTIFIES LONG CODE PHASE DIFFERENCE INFORMATION ASSOCIATED WITH THE NEIGHBORING BASE STATIONS TO HOST STATION

各基地局は周辺基地局とのロングコード位相差情報を上位局に通知

STEP 2: MOBILE STATION NOTIFIES TO BASE STATION A THE LONG CODE PHASE DIFFERENCE BETWEEN BASE STATION A AND BASE STATION B.

手順 2：移動局は基地局Aおよび基地局Bのとまり木チャネルのロングコード位相差を基地局Aに通知

手順 1：移動局は基地局Aおよび基地局Bのとまり木チャネルのロングコード位相差を測定

移動局が基地局Aから基地局BにSHOする場合

WHEN THE BASE STATION PERFORMS SHO FROM BASE STATION A TO BASE STATION B

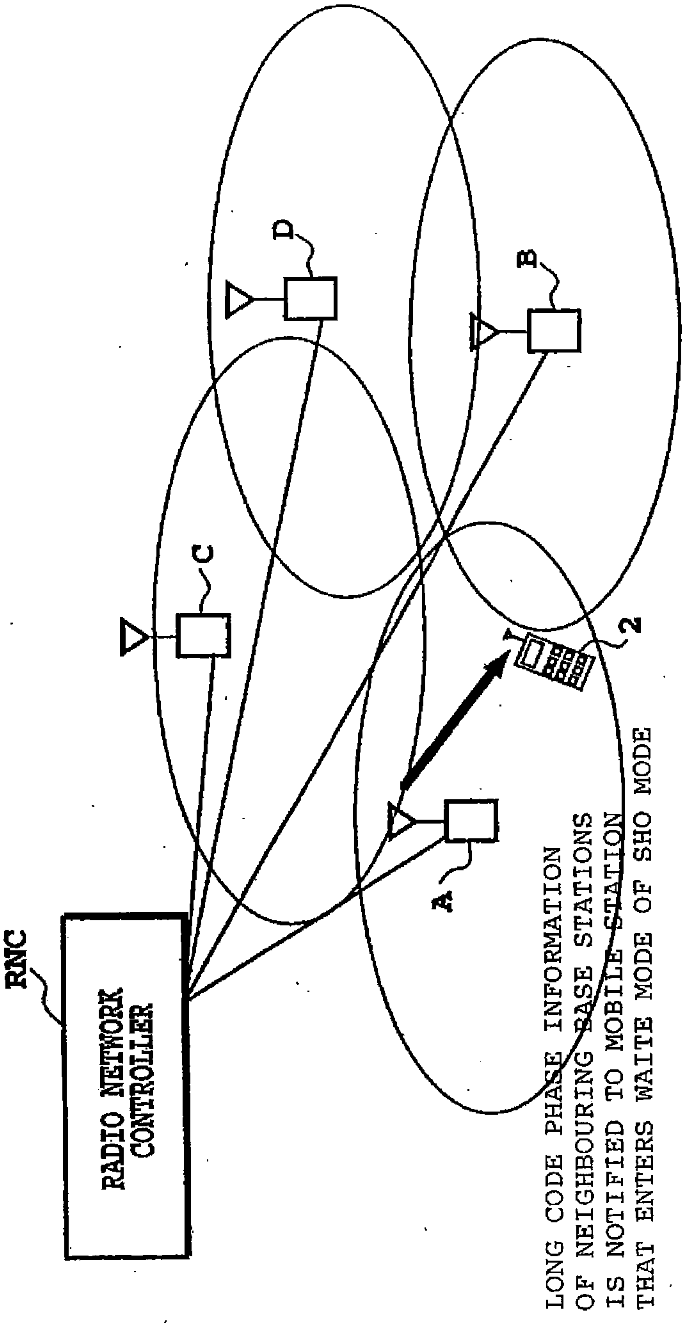
STEP 1: MOBILE STATION MEASURES A LONG CODE PHASE DIFFERENCE IN PERCH CHANNEL BETWEEN BASE STATION A AND BASE STATION B.

(Fig. 4)

MANAGEMENT TABLE
(STORING LONG CODE PHASE INFORMATION)

LONG CODES OF NEIGHBORING BASE STATIONS	LONG CODE PHASE DIFFERENCE INFORMATION
1101001100 ···	Δ1
1101000011 ···	Δ2
1101001010 ···	Δ3
1101001111 ···	Δ4
1101000000 ···	Δ5
1101000001 ···	Δ6
:	
:	
1101001011 ···	Δ (N−1)
1101001001 ···	ΔN

(Fig. 5)


RNC
RADIO NETWORK CONTROLLER
A
B
C
D
2

LONG CODE PHASE INFORMATION OF NEIGHBOURING BASE STATIONS IS NOTIFIED TO MOBILE STATION THAT ENTERS WAITE MODE OF SHO MODE

VIA eFILE

PATENT APPLICATION
Docket No. 13768.783.43

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of		)
	Eric Gould Bear	)
Serial No.:	10/429,933	) Art Unit) 2629
Filed:	May 5, 2003	)
Conf. No.:	1399	)
For:	CONTROL AND COMMUNICATIONS PANEL FOR A COMPUTER SYSTEM	)
Examiner:	Seokyun Moon	)
Customer No.:	47973	)

TRANSMITTAL FOR AMENDMENT "A" AND RESPONSE

Via E-File - Amendments
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Transmitted herewith is an Amendment "A" for entry in the above-identified application.

___ To secure the approval of the Examiner for proposed amendments to the drawings, enclosed are the following:

___ Letter to the Official Draftsperson;

___ Set of __________ (___) sheets of drawings containing Figures __________ including the proposed amendments therein; and

___ A duplicate set of the __________ (___) sheets of drawings with the changes therein highlighted in red.

___ To render the transmitted Amendment "A" timely filed attached is the following:

___ Petition for a (0)-Month Extension of Time; and

___ Payment in the amount of $0.00 using the Credit Card payment option in E-Filer with RAM will be used to cover the following fees:

___ the $0.00 petition fee for the (0)-month extension of time.

___ the $0.00 additional claim fee.

X No other additional claim fee is required.

The fee has been calculated as follows:

			SMALL ENTITY		LARGE ENTITY	
CLAIMS REMAINING AFTER	HIGHEST NO. PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE	ADDT'L FEE	RATE	ADDT'L FEE
TOTAL 55	MINUS 57	=	X		X $50.00	0.00
INDEPENDENT 3	MINUS 3	=	X		X $200.00	0.00
1st PRESENTATION OF MULTIPLE DEPENDENT CLAIM			+_____		+_____	
			TOTAL		TOTAL	0.00

X The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 23-3178.

X Any filing fees under 37 CFR 1.16 for the presentation of extra claims.

X Any patent application processing fees under 37 CFR 1.17.